ULTRASONIC BLADE DESIGN FOR SCORING DOUBLE ANGLE GROOVE AND PRODUCTS THEREFROM

Cross-Reference to Related Applications

This application claims priority to U.S. Provisional Application Serial No. 60/411,458, filed September 17, 2002, and is herein incorporated by reference.

Field of the Invention

The present invention relates to a method for scoring double-angle weakening grooves in skin material and products produced therefrom. The invention has particular utility in the field of automotive applications, specifically, the backside of skin sections covering airbag deployment systems

Background of the Invention

A common type of interior trim panel or cover used to cover and hide the air bag in a motor vehicle may comprise a thin elastic plastic outer skin having a non-glaring grained outer surface, a rigid retainer or substrate and an intermediate layer of soft plastic foam between the skin and substrate. In some cases the foam is omitted.

It is common practice to use vinyl, typically polyvinyl chloride (PVC), to form the thin plastic outer shell or skin for the panel. The skin material may also comprise urethanes (e.g., PU), olefins (e.g., PP, PS, TPO, ETP-TPO), esters (e.g., COPE), styrenes (e.g., AAS, ASA) and rubbers (e.g. TPO,ETP-TPO, ABS) in various compositions.

The present invention relates to those trim panels or covers wherein the skin is formed of a thermoplastic polymer or thermosetting resin and is provided with an invisible tear seam, and the substrate includes one or more doors that are impacted by the inflating air bag and press against the cover to separate the tear seam and then swing outward to form an opening in the cover for deployment of the air bag into a protective

position in the passenger space. These tear seams are provided in various configurations or patterns with the most common having a C, H, U, or X-shape and wherein the pattern determines the number of doors required in the substrate.

To develop tearing and/or breaking, air bag doors that are integrally formed with automotive trim or instrument panels will sometimes include regions of weakened materials, reduced thickness or scoring, all of which are commonly referred to as "tear seams". Tear seams are weakened areas designed to preferentially tear and/or break when an air bag inflates and forces the doors to open.

It is desirable that the tear seams and thereby the presence of the air bag be hidden from view for various reasons and heretofore, this has been accomplished in several different ways. Such a tear seam is commonly referred to as an "invisible tear seam". One way of providing such an invisible tear seam is by forming a tear seam defining groove or series of depressions in the backside of the skin. This leaves a thin and thereby weakened section at the outer or appearance side of the skin that defines the tear seam without outwardly revealing its presence during normal view by an ordinary vehicle occupant. Examples of such invisible air bag cover tear seams are disclosed in United States Patent Nos. 5,072,967; 5,082,310; 5,316,822; 5,348,339; 5,632,914; 5,863,064 and 5,961,143.

A variety of disclosures exist directed at preweakening a skin section employed in an automotive airbag deployment system.

U.S. Patent Nos. 4,524,894 and 4,805,390 are directed at the use of an apparatus for cutting patterns and a groove cutting machine to provide a constant thickness of material remaining after the cutting process.

U.S. Patent Nos. 5,803,489 and 5,968,381 are directed to an air bag cover with a tear line with a predetermined wall thickness which tapers from the inside towards the outside with a width of 120-190 microns.

U.S. Patent 6,308,391 discloses a method of producing V-shaped grooves

machines in the surface of different materials. The V-shaped grooves have a predetermined depth relative to the surface. The V-shaped grooves are of a single angle.

Other background disclosures include U.S. Appln. Nos. 10/027,779; 09/778,394; 10/251,897; 10/241,366; GB 2,276,354; JP 6218811; and EP 1177878.

When soft plastic or elastomeric skin materials are used as a cover skin for an air bag deployment system, it is not uncommon for the skin material that forms the invisible tear seam in the backside of the cover skin to heal or stick together if an insufficient amount of material is not removed when the tear seam is formed. Thus, the angle of the side walls of the seam is critical. Additionally, some higher powered laser weakening systems may cause degradation of the skin surface where it has been thinned or weakened, resulting in a tear seam that remains tacky. A further issue with these systems is the smoke produced, making the work area quite unpleasant.

An alternate method to laser weakening involves the use of a knife-blade which may score the backside of the cover skin to a known depth, thus providing a line of mechanical weakness or tear seam. The knife blade may be heated or excited by another source of energy such as ultrasonics to provide a reliable cut or scoring line. The scoring need not be a continuous groove but may be intermittent and vary in depth dependent on where the tearing of the seam is desired to initiate and propagate.

It is therefore desirable to provide a knife-blade design that prevents healing of the tear seam, particularly for soft elastomeric skin materials.

Summary of the Invention

The present invention relates to a blade design for scoring double angle V-grooves in the backside of plastic shells to provide a preweakened section. The double angle V-groove may be located at the airbag deployment opening of a vehicle.

It is therefore an object of the present invention to provide a knife-blade having a double angle design which allows for the removal of sufficient material from the tear seam to prevent healing of the sides of the groove back together.

It is a further object of the present invention to provide a double angle knife-blade which provides an invisible tear seam by removing a portion of the skin material at an angle that prevents healing while leaving sufficient material remaining at the base of the groove or tear seam such that readout on the front side of the skin is prevented.

It is a further object of the present invention to provide a knife blade design which can be used on both freshly molded as well as aged shells and allow scoring at a reasonably high rate of speed.

Brief Description of the Drawings

FIG. 1 is a side view of the preferred ultrasonic knife blade used in the present invention.

FIG 2 is a front view of the knife blade of **FIG. 1.**

FIG. 3 is an enlarged view of the knife blade tip of **FIGS. 1** and **2.**

Detailed Description of the Preferred Embodiments

Fig. 1 illustrates a side view of the preferred ultrasonic blade that can be used in accordance with the present invention. However, it should be appreciated that in broad context, any blade that operates to provide the V-shaped groove described herein is contemplated.

With attention directed to FIG. 2, as illustrated therein the blade contains a double angle V-shaped configuration. Shown at **10** is the first angle cutting surface **A** which

angle is less than the angle of cutting surface B which is shown generally at **12**. In the context of the present invention, angle A is preferably between 5-30 degrees and angle B is between 75-150 degrees. In addition it should be understood that the present invention contemplates all values therebetween in one (1) degree increments. More preferred ranges therefore include angle A of 10-20 degrees and angle B of 90-130 degrees. In a most preferred embodiment, angle A is about 15 degrees and angle B is about 110 degrees. Attention is directed to **FIG. 3** which illustrates angle A of 15 degrees and angle of B of 110 degrees.

It has been found that the above referenced double angle V-shaped design minimizes the weakening line visibility produced therefrom, enhances deployability, while preventing blocking of the skin material. In other words, the skin material is not prone to heal to itself after the cutting operation, by virtue of the double angle configuration.

Preferably, the skin material comprises a thermoplastic polymer, such as poly(vinyl chloride) or polyurethane, thermoplastic elastomers, thermoplastic olefins, and other skin materials utilized for vehicle interiors. Preferably the blade has a flat front edge (**14**) as shown in FIG. 1 which also indicates generally the path of knife travel.

Preferably the groove is 0.045" wide at the top with 0.020" – 0.028" of material at the bottom thereof.